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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 79 GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICITY — POWER SYSTEM PLANNING AND MANAGEMENT

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NATIONAL FOREWORD

This Indian Standard (Part 79) which is identical with IEC Pub 50 (603) (1986) 'International electrotechnical vocabulary — Chapter 603 : Power system planning and management, transmission and distribution of electricity — Generation', issued by the International Electrotechnical Commission (IEC), was adopted by the Bureau of Indian Standards on the recommendation of the Basic Electrotechnical Standards Sectional Committee and approval of the Electrotechnical Division Council.

Only the English text given in the IEC publication has been retained while adopting as Indian Standard, and as such the page numbers given here are not same as in IEC Publication.

Indian Standard
ELECTROTECHNICAL VOCABULARY
PART 79 GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICITY — POWER SYSTEM PLANNING AND MANAGEMENT

SECTION 603-01 — POWER SYSTEM PLANNING

Preliminary note

In the context of this chapter, the terms "network" and "system" can be considered as practically synonymous and correspond to the French term "reseau".

For the purpose of the following definitions, the term "system" has been used but "network" can be preferred in some countries or some situations.

603-01-01

power system planning

The whole range of studies involved in the development of a technically and economically sound system of electricity supply.

603-01-02

load density

The quotient of load and area of the zone geographically accessible to a given distribution network.

603-01-03

load centre

The point, in an area, at which the sum of the products of each load and its distance from this point is a minimum.

603-01-04

load forecast

An estimate of the expected load of a network at a given future date.

603-01-05

generation mix forecast

An estimate of the composition of a generation system at a given future date.

603-01-06

transmission capacity of a link

The maximum permissible load of a link considering its relevant physical and electrical characteristics under specified conditions.

603-01-07

short-circuit current capability

The permissible value of the shortcircuit current in a given network component for a specified duration.

SECTION 603-02 — NETWORK CALCULATION

603-02-01

network calculation

The computation of system state variables of a network by using system parameters and other known system state variables.

603-02-02

system state variables

The variable quantities associated with the electrical state of a system.

Examples :

Voltages, currents, powers, electric charges, magnetic fluxes.

603-02-03

system parameters; system constants

The quantities considered as being fixed and which characterize the system components.

Examples :

Impedance, admittance, transformation ratio.

603-02-04

network topology

The relative position of the ideal elements representing an electric network.

603-02-05

topological diagram of a network

The graphical representation of the network topology.

603-02-06

steady state of a system

The operating conditions of a network in which the system state variables are considered to be sensibly constant.

603-02-07

transient state of a system

The operating condition of a network in which at least one of the state variables is changing, usually for a short period.

603-02-08

load flow calculation

A steady-state network calculation where the known variables are input and output powers at the nodes and possibly voltages at specified nodes.

603-02-09

state estimation

The computation of the most probable currents and voltages within the network at a given instant by solving a system of mostly non-linear equations whose parameters are obtained by means of redundant measurements.

603-02-10

short-circuit calculation

The computation of the currents and voltages within a network subjected to a short circuit.

603-02-11

equivalent network

A network which may replace a given network without changing the state variables at specified boundary nodes.

603-02-12

network conversion; network transformation

The transformation of a network into a calculated equivalent network.

603-02-13

star-polygon conversion; star-polygon transformation

A network conversion by reduction of the number of nodes.

603-02-14

delta-wye conversion; delta-star transformation

A network conversion by reduction of the number of meshes.

603-02-15

active network

A network including voltage sources and/or current sources.

603-02-16

passive network

A network including neither voltage sources nor current sources.

603-02-17

passive equivalent network

The equivalent network resulting from a network conversion applied only to the system parameters.

603-02-18

balanced state of a polyphase network

The condition in which the voltages and currents in the phase conductors form balanced polyphase sets.

603-02-19

unbalanced state of a polyphase network

The condition in which the voltages and/or currents in the phase conductors do not form balanced polyphase sets.

603-02-20

series impedance; longitudinal impedance

The impedance between the phase terminals in the two-port network equivalent to a given network component.

603-02-21

shunt admittance

The admittance between a definite phase node and the reference terminal in the two-port network equivalent to a given network component.

603-02-22

fault impedance

The impedance at the point of the fault between the faulted phase conductor and earth (ground) or between the faulted phase conductors themselves.

Example :

Arc resistance.

603-02-23

surge impedance of a line

The quotient of the voltage and the current of a wave travelling along a line of infinite length having the same parameters as the given line.

603-02-24

natural load of a line

That value of power carried by a line for which the line appears purely resistive due to the reactive power originating from the capacitance and the inductance of the line being equal.

603-02-25

fault current

The current flowing at a given point of a network resulting from a fault at another point of this network.

603-02-26

short-circuit current

The current flowing at a given point of a network resulting from a short circuit at another point of this network.

603-02-27

current in the fault

The current flowing through the fault.

603-02-28

current in the short circuit

The current flowing through the short circuit.

603-02-29

reference node

The node of a network where the phase of the node voltage in the complex plane is arbitrarily fixed, and with reference to which the phases of the system state variables are measured.

603-02-30

infinite bus

A network node whose voltage is predetermined and remains constant in magnitude, phase and frequency under all loading conditions.

603-02-31

balancing bus

The node of a network the input power of which is controlled so as to equalize the sum of all other input powers and the active power losses of the network.

603-02-32

slack bus

An infinite bus where the voltage magnitude is predetermined and which is at the same time reference node and balancing bus.

603-02-33

load bus; PQ bus

A node with predetermined active and reactive input power.

603-02-34

voltage controlled bus

A node with predetermined active input power and node voltage magnitude.

603-02-35

passive bus

A node with zero input active and reactive power.

603-02-36

incidence matrix

A matrix describing the topology of the network.

Examples :

Branch-bus incidence matrix, branch-mesh incidence matrix.

603-02-37

bus admittance matrix; Y bus matrix

A matrix enabling the dependence of the node input currents on the node voltages to be expressed.

603-02-38

bus impedance matrix; Z bus matrix

The inverse bus admittance matrix.

603-02-39

mesh impedance matrix

A matrix enabling the dependence of the mesh voltages on the mesh currents to be expressed.

603-02-40

redundancy factor

Numerical value characterizing the set of measurements available for the state estimation of a network.

$$r = \frac{m}{2n - 1} - 1$$

where :

r = redundancy factor

m = number of measurements in the network

n = number of nodes of the network

SECTION 603-03 — STABILITY

603-03-01

power system stability

The capacity of a power system to regain a steady state, characterized by the synchronous operation of the generators after a disturbance due, for example, to variation of power or impedance.

603-03-02

steady state stability of a power system

A power system stability in which any disturbances occurring have only small rates of change and small relative magnitudes.

603-03-03

transient stability of a power system

A power system stability in which disturbances may have large rates of change and/or large relative magnitudes.

603-03-04

conditional stability of a power system

A steady-state stability condition of a power system that can only be achieved with the assistance of automatic control.

603-03-05

inherent stability of a power system

A power system stability that exists without the assistance of automatic control.

603-03-06

internal angle of an alternator

The phase difference between the terminal voltage of an alternator and its electromotive force.

603-03-07

angle of deviation between two e.m.f.'s

The phase difference between the e.m.f. of an alternator taken as a reference and that of another alternator or that of an infinite bus.

603-03-08

swing curve

The diagram of the value of a given system state variable against time, following a disturbance.

603-03-09

load stability

The capability of a load consisting of rotating machines to regain a steady state of operation after a disturbance.

603-03-10

stability limit of a system state variable

The critical value of a given system state variable which cannot be exceeded without endangering power system stability.

Note. — For a power system without a fault this concept is related to the steady-state stability of the system.

603-03-11

stability margin of a system state variable

The difference between the actual value of a given system state variable and its stability limit.

603-03-12

stability zone

The operating area situated within the stability limits of the system state variables.

603-03-13

synchronous operation of a machine

The ideal operating condition of a synchronous machine connected to the network in which the electrical angular velocity of the machine corresponds with the network frequency.

Note. — Under practical operating conditions the angular velocity of the machine may slightly oscillate around the ideal value.

603-03-14

synchronous operation of a system

The condition of a system in which all machines are in synchronous operation.

603-03-15

asynchronous operation of a synchronous machine

The non-synchronous operation of a synchronous machine in which the asynchronous generating torque is equal to the prime mover torque or in which the asynchronous motor torque is equal to the motor shaft-torque.

603-03-16

out-of-step operation

The operating condition of a group of interconnected synchronous machines in which the angles of deviation between two or more machines vary up to the final loss of synchronism or until synchronism is restored.

603-03-17

hunting of interconnected synchronous machines

The oscillation between interconnected synchronous machines in which the angles of deviation swing on both sides of a mean value.

603-03-18

synchronization of two systems

The matching of two systems with respect to their frequency and to their voltage magnitude and voltage phase for interconnection purposes.

603-03-19

self-synchronization

The process of synchronization of an unloaded and unexcited synchronous machine that is excited either at the same time as it is coupled to the system or shortly afterwards.

603-03-20

synchronism restoration

The process by which a synchronous machine recovers the synchronous operation after having operated out of synchronism.

SECTION 603-04 — POWER SYSTEM CONTROL

603-04-01

power system management

The effective operation of generation, transmission and distribution facilities so as to assure adequate security of supply at minimum cost.

603-04-02

generation schedule

The scheduling of generation facilities for a specified period.

603-04-03

system demand control

The control of the power demand of the consumers on a power system.

603-04-04

primary control

(of the speed of generating sets)

The control of the speed of each generating set by its individual governor which ensures that the driving torque is a function of the system frequency.

603-04-05

secondary control

(of active power in a system)

Coordinated control of the active power supplied to the network by particular generators.

603-04-06

power/frequency control

Secondary control of the active power of generating sets in response to variations in system frequency and to the variations in the grand total of active power exchanged with the interconnected systems.

603-04-07

adaptive control

Secondary control whose characteristics are time-variable and result from the optimisation of some operational conditions.

603-04-08

droop of a set

The ratio of the per-unit change in frequency $(\Delta f)/f_n$ (where f_n is the normal frequency) to the per-unit change in power $(\Delta P)/P_n$ (where P_n is the nominal active power of the rotating machine).

$$\sigma = (\Delta f/f_n)/(\Delta P/P_n)$$

603-04-09

droop of a system

For a power system the ratio of the per-unit change in frequency to the corresponding per-unit change in active power demand.

603-04-10

regulating energy of a system; power/frequency characteristic

For a power system the quotient of the change of active power demand by the corresponding change of frequency in the absence of secondary control.

603-04-11

controlling power range

The sum of active power control ranges of the generating sets acted upon by the system regulator.

603-04-12

synchronous time

The time indicated by a synchronous clock.

603-04-13

deviation of synchronous time

Deviation of synchronous time from standard time.

603-04-14

steady-state load characteristic

The relation between the power absorbed by a load and the voltage or frequency at the load terminals under steady-state operating conditions.

603-04-15

transient load characteristic

The relation between the power absorbed by a load and the voltage or frequency under transient-state operating conditions.

603-04-16

power-regulation coefficient of load

The first derivative with respect to voltage of the power-voltage steady-state load characteristic.

603-04-17

scheduled operation

(of a generating set)

Operation of a selected generating set at constant power, or on successive steps of power, the values of which are previously specified, within a given period of time.

603-04-18

(secondary) power control operation

(of a generating set)

Operation of a selected generating set at changing power following instructions received from the secondary control device.

603-04-19

control range

(of a generating set)

The specified range of active power within which a power-controlled generating set must be able to operate.

603-04-20

base load set

A generating set whose purpose is to run continuous duty under operating conditions approaching full load for as long as that operation mode is electronic.

603-04-21

Controllable set

A generating set whose purpose is to run at load levels varying according to the needs of the network supplied as long as that operational mode is economic.

603-04-22

peak load set

A generating set whose purpose is to run under discontinuous load conditions and to respond rapidly to peaks in the power demand of the network.

603-04-23

voltage control

The adjustment of the network voltages to values within a given range.

603-04-24

voltage map

Consistent presentation of the voltages at the major nodes of a network under specified operating conditions.

603-04-25

in-phase (voltage) control

Voltage control by means of an addtional variable in-phase voltage component.

603-04-26

quadrature (voltage) control

Voltage control by means of an additional variable quadrature voltage component.

603-04-27

reactive-power voltage control

Voltage control by the adjustment of reactive power generation in a power system.

603-04-28

reactive power compensation

An action to optimise the transmission of reactive power in the network as a whole.

603-04-29

series compensation

The reduction of the series impedance of a line by the insertion of series capacitors.

603-04-30

shunt compensation

The change of reactive power at a point of a network by means of reactors, capacitors or synchronous compensators, shunt connected to the network.

603-04-31

network splitting; islanding (USA)

An emergency measure comprising the division of a power system into subsystems in each of which there is an attempted balance between generation and load to achieve isolated operation.

603-04-32

load shedding

The process of deliberately disconnecting preselected loads from a power system in response to an abnormal condition in order to maintain the integrity of the remainder of the system.

603-04-33

isolated operation

The stable and temporary operation of a discrete part of a power system after network splitting.

603-04-34

separate network operation

The operation of a power system disconnected from neighbouring power systems.

603-04-35

parallel operation

1. The operation of interconnected power systems in synchronism.
2. The operation of network components connected in parallel, such as lines, transformers, generators.

603-04-36

interconnected operation

The operation of two or more networks interconnected by links (for example : lines, transformers, d.c. links) enabling the mutual exchange of electrical energy.

603-04-37

ring operation of a part of a network

The method of operation where each point of a given part of a network is fed from one or two sources along two distinct paths.

Note. — This method of operation is called :

- "closed ring" if each point of the network is normally fed along two paths ;
- "open ring" if each point of the network can be fed along either of two paths.

603-04-38

radial operation
(of a part of a network)

The method of operation where each point of a given part of a network is fed along one path only.

603-04-39

ring closing

1. The transition from radial operation to ring operation.
2. Establishing a ring connection.

603-04-40

ring opening

1. The transition from ring operation to radial operation.
2. Breaking a ring connection.

603-04-41

interruptible load

The load of particular consumers which, according to contract, can be disconnected by the supply undertaking for a limited period of time.

603-04-42

controllable load

The load of particular consumers which under contract must be reduced, for a limited period of time, at the request of the distribution supply undertaking.

603-04-43

loss of load

A sudden reduction of the power demand of the network.

603-04-44

power shortfall

A lack of available power with respect to the power demand at any moment in time.

603-04-45

energy shortfall

A lack of available energy with respect to the energy demand over a stated period of time.

SECTION 603-05 — POWER SYSTEM RELIABILITY*

603-05-01

reliability of an item

The ability of an item to perform a required function under stated conditions for a specified period of time.

---

* See also, IEV Chapter 191 :Reliability, Maintainability and quality of service (in preparation).

603-05-02

service reliability

The ability of a power system to meet its supply function under stated conditions for a specified period of time.

603-05-03

service security

The capability of a power system at a given moment in time to perform its supply function in the case of a fault.

603-05-04

availability

The state of an item of being able to perform its required function.

603-05-05

outage; unavailability

The state of an item of being unable to perform its required function.

603-05-06

failure

The termination of the ability of an item to perform a requried function.

603-05-07

planned outage; scheduled outage

Outage due to the programme taking out of service of an item.

603-05-08

forced outage

Outage due to the unscheduled putting out of service of an item.

603-05-09

availability factor

The ratio of the up duration to the period of time under consideration.

603-05-10

unavailability factor

The ratio of the down duration to the period of time under consideration.

603-05-11

interruption of supply

The loss of supply to one or several consumers.

603-05-12

primary failure

Failure of an item not caused either directly or indirectly by the failure of another item.

603-05-13

secondary failure

Failure of an item caused either directly or indirectly by the failure of another item.

603-05-14

common mode failure

Occurrence of multiple-primary failures having a common cause.

603-05-15

operating duration

Within a specified period of time, the time during which an item has performed its required function.

603-05-16

stand-by duration

Within a specified period of time, the time during which an item was capable of performing its function but was not actually called upon to do so.

603-05-17

up duration

The sum of the operating duration and the stand-by duration within a specified period of time.

603-05-18

down duration; outage duration

Within a specified period of time, the time during which an item has been incapable of performing its function.

603-05-19

planned-outage duration; scheduled outage duration

Within a specified period of time, the time during which an item was not available to perform its function because it had been withdrawn from service according to programme.

603-05-20

maintenance duration

Within a specified period of time, the time during which maintenance was carried out on an item which was thus not available to perform its function.

603-05-21

forced-outage duration

Within a specified period of time, the time during which an item was incapable performing its function because of a fault.

603-05-22

repair duration

The period of time needed to repair a damaged item.

603-05-23

interruption duration

The time from the beginning of an interruption of supply to a consumer until supply has been restored.

603-05-24

outage rate

For a particular class of outage and a specified period of time, the quotient of the number of outages by the up duration for an item.

Examples — This concept may be applicable for example to scheduled-outage rate, forced-outage rate.

SECTION 603-06 — ECONOMIC OPTIMIZATION

603-06-01

management forecast of a system

The preparation and checking of the programmes for the generation of electricity, means of storage and release, including network diagram analysis for providing the most economic supply of expected loads with the necessary security within a given period of time, in a given system, all present and foreseeable circumstances being taken into account.

603-06-02

optimum load

The load of a network component for which the sum of the present values of cost under given conditions is a minimum.

603-06-03

economic loading schedule

The most economic use of the available components of the network.

603-06-04

power losses

The difference at a given moment in time between the total active input power and the total active output power in a network.

603-06-05

energy losses

The time integral of power losses.

603-06-06

transmission losses

Losses occurring in the equipment involved in a transmission network.

603-06-07

distribution losses

Losses occurring in the equipment involved in a distribution.

603-06-08

utilization time of power losses

The quotient of energy losses and the peak value of the power losses within a specified period of time.

603-06-09

(energy) loss factor

The ratio of the utilization time of power losses to the period of time under consideration.

603-06-10

present value of cost losses; present worth of cost of losses (USA)

The sum of annual costs of losses calculated to present values.

603-06-11

supply-interruption costs

Conventional costs used in economic studies to evaluate the consequences to the community of an interruption of supply.

603-06-12

reinforcement of a system

Addition or substitution of some items in a power system (transformers, lines, generators, etc.) so that it will be able to meet an increased load or provide a better quality of supply.

603-06-13

"target" system

An anticipated model of a power system, designed to ensure the supply of long-term foreseeable loads (including power as well as location) and which constitutes a guide for the choice of a method of reinforcement in the short term.

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